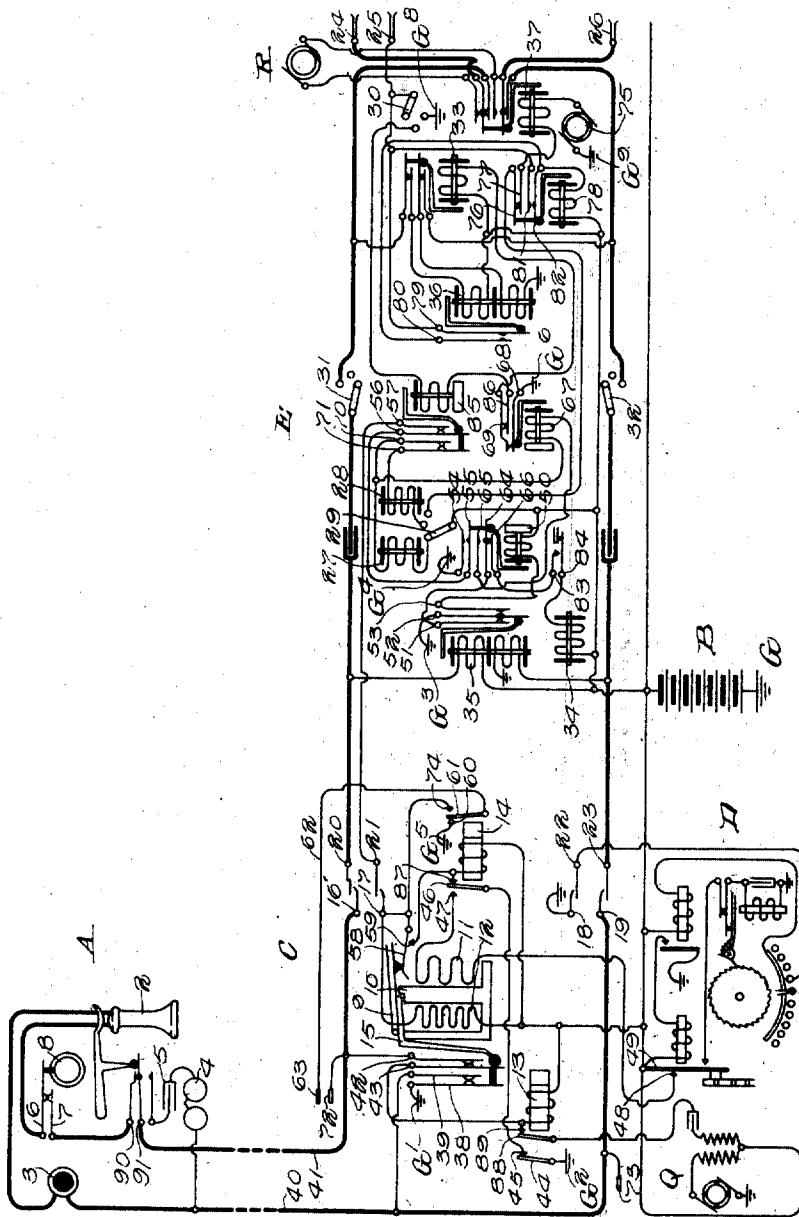


J. E. COOLEY.
 AUTOMATIC TELEPHONE SYSTEM.
 APPLICATION FILED JAN. 23, 1914.

1,212,908.

Patented Jan. 16, 1917.



WITNESSES

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AUTOMATIC TELEPHONE SYSTEM.

1,212,908.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, JEROME E. COOLEY, a citizen of the United States of America, and resident of Manhattan, Riley county, Kansas, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

My invention relates to improvements in automatic telephone systems, and more particularly to improved means for giving the calling subscriber a busy signal when the called line is busy, and for preventing the apparatus employed in establishing a connection from being unnecessarily tied up when the called line is busy.

Heretofore, in automatic systems, it has been customary to associate a busy signaling machine with the connector, and when this connector attempted to establish connection with a busy line, this busy signaling machine was brought into operation to thus inform the calling subscriber that the called line is busy. Then when the calling subscriber hung up his receiver, the connection would be released. The trunks and switches employed in establishing the connection would thus be inaccessible for further use during the period that the busy signal was being given and until the calling subscriber hung up his receiver. By my invention, however, I prevent the switches being tied up in this manner in that I provide means whereby all switches employed in establishing a connection will immediately be released when an attempt is made to establish connection with a busy line, and the busy signaling machine, instead of being associated with the connector switch, as heretofore, is associated with the individual line switch of the calling line. When this line switch releases for any reason while the calling subscriber has his receiver off the hook, the busy signaling machine is connected with the calling line to thus give the usual busy signal to the calling subscriber.

These and other features and objects of my invention will be more readily understood by reference to the accompanying drawing, in which I have illustrated one embodiment of my invention in connection with certain automatic switches of a well-known type.

The drawing shows an automatic substation and the central office apparatus of an automatic telephone system embodying the principles of my invention. The central office equipment shown herein comprises only the so-called line switch and connector switch, but it will be clearly understood by those versed in the art that so-called selector switches may be inserted in the system, thereby increasing the capacity of the exchange without departing from the principles of my invention. The so-called selector switches may be of a type similar to the selector switch shown in British patent to T. G. Martin No. 1,419 of 1910.

The substation A shown herein may be of any suitable or approved type and comprises the usual receiver 2, transmitter 3, ringer 4 and condenser 5. Being an automatic substation it is also provided with an impulse transmitter or calling device which is represented herein by a pair of impulse springs 6 and 7 and an impulse wheel 8, which latter is assumed to be controlled through the medium of a finger hole dial (not shown) in such a manner that the impulse springs 6 and 7 may be momentarily separated a number of times corresponding to each digit of the number to be called.

The line switch C which is associated with the line of the substation A is of the general type of line switch shown in British patent to T. G. Martin No. 1419 of 1910, above referred to; the circuits being slightly modified to operate in a system embodying my invention. This line switch comprises, among other details, a plunger (not shown) attached to the end of a so-called plunger arm 9 which is controlled by the magnet 10. The magnet 10 comprises two windings, namely, the pull-in winding 11 and the holding or cut-off winding 12. The winding 11 operates both the plunger arm 9 and the cut-off armature 15, while the winding 12 is only strong enough to operate the armature 15 and to hold the plunger arm 9 in an operated position after it has once been operated by the pull-in winding 11. The circuit of the pull-in winding 11 is controlled by the line relay 13 and the relay 14, both of which I preferably make slow acting, i. e., they are slow to deenergize after their energizing circuits have been broken. The relay 13 also

controls a circuit from the busy machine Q through the contacts 88 and 89. When the plunger arm 9 is operated, the plunger is forced into a bank of contact springs, forcing the springs 16, 17, 18 and 19 into engagement with the springs 20, 21, 22 and 23, respectively. Although only one set of springs (16-23) is shown, each line switch is provided with a plurality of such sets, each set forming the terminal of a trunk line leading to a connector switch E. Each trunk line is connected in multiple with the corresponding springs of all the switches of the group which is controlled by the master switch D.

The master switch D is of the same general type as that disclosed in British patent to R. W. James No. 26,301 of 1906, being, however, of the particular type disclosed in the above-mentioned British Patent No. 1419 of 1910. The function of the master switch, as is well known, is to maintain the plungers of all the idle line switches in position to engage the terminal of an idle trunk line.

The connector switch E is of the same general type of connector switch disclosed in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson, the circuits, however, being modified to adapt the switch to operate in a system in which the central office apparatus is controlled by impulses delivered over the two sides of the line in series. The circuits are also otherwise slightly modified to operate in a system embodying the principles of my invention. The connector is provided with a shaft (not shown) carrying the wipers 24, 25 and 26. The shaft is controlled by the vertical magnet 27 and the rotary magnet 28. The usual side switch comprising the wipers 29, 30, 31 and 32 is controlled by the private magnet 33 in the usual well-known manner. The magnet 34 is the usual release magnet. The operations of the switch are controlled through the medium of the double-wound line relay 25, through which the calling subscriber receives talking current. The called subscriber receives talking current through the so-called back-bridge relay 36. The ringing relay 37 is the means through which ringing current is applied to the called line.

A general description of the apparatus having been given, it will now be explained how a connection is established between a substation A and a called substation (not shown). It will also be explained how, if the called substation is busy, all of the apparatus is automatically released and returned to normal position, whereby the trunks are kept from being made busy and the calling subscriber is given a busy signal through the medium of his individual line switch C.

It will be assumed that the number of the called substation is 20. Upon the removal of the receiver from the switch-hook at the substation A preparatory to making a call, an energizing circuit is closed through the line relay 13 of the line switch C. This circuit extends from ground G' through the springs 38 and 39, conductor 40, through the substation A, conductor 41, springs 42 and 43 and the line relay 13 to battery B, thence through battery B to ground. The line relay 13, upon energizing, operates to close the circuit of the pull-in winding 11. This circuit extends from ground G' through the springs 44 and 45, springs 46 and 47, pull-in winding 11 and the springs 48 and 49 to battery B. The pull-in winding 11 operates to cause the armature 15 to force the springs 38 and 43 out of engagement with the springs 39 and 42, respectively, and also operates to force the plunger on the plunger arm 9 into the bank of contacts 16 to 23, inclusive. The disengagement of the springs 38 and 43 from the springs 39 and 42 opens the circuit of the line relay 13. The line relay 13 being slow acting does not fall back immediately, however, but holds the plunger arm in an operated position until a holding ground is supplied to the holding winding 12 from the connector E. The engagement of the springs 16 and 19 with the springs 20 and 23, respectively, extends the subscriber's line to the line relay 35 of the connector E. The line relay 35, of the connector switch E is thereupon energized, closing a circuit through the relay 50. This circuit extends from ground G' through the contact of the springs 52 and 53 and the relay 50 to battery B. The relay 50, upon energizing, closes the above-mentioned holding circuit through the cut-off winding 12. This circuit extends from ground G' through the springs 54 and 55, springs 56 and 57, bank springs 21 and 17 and the cut-off winding 12 to battery B. The winding 12, upon energizing, holds the armature 15 and the plunger 9 in their operated positions after the circuit of the pull-in winding is broken by the opening of the springs 44 and 45. The energization of the relay 50 also closes an energizing circuit for the slow acting relay 14 of the line switch. This circuit extends from ground G' through the springs 54 and 55, springs 56 and 57, bank springs 21 and 17, springs 58 and 59 and the relay 14 to battery B. The relay 14, upon energizing, closes a circuit extending from ground G' through the springs 60 and 61 and the conductor 62 to the connector private bank contact 63, which guards against the substation A being seized by a connector switch. The energization of the relay 50 also prepares a circuit for the vertical magnet of the connector by bringing into engagement the springs 64 and 65 and opens

the circuit of the release magnet 34 at the springs 64 and 66. The calling subscriber now operates his calling device for the first digit 2 of the called number, whereby the substation impulse springs 6 and 7 are operated twice momentarily, each time breaking the circuit of the connector line relay 35. The relay 50 of the connector being slow acting does not deenergize during the momentary interruptions of its circuit by the line relay 35 and consequently each time the latter deenergizes, an impulse is transmitted through the vertical magnet 27. This circuit extends from ground G^a through the springs 52 and 51, springs 64 and 65, relay 67, vertical magnet 27 and the side switch wiper 29 (in first position) to battery B. The vertical magnet 27 receives two impulses over this circuit and operates to raise the switch wipers 24, 25 and 26 to a position opposite the second level of bank contacts. The relay 67, which was included in series with the vertical magnet, remains energized during the entire time that impulses are being transmitted through it and operates to close the circuit of the private magnet 33. The circuit for the private magnet 33 extends from ground G^a through the springs 68 and 69 and the private magnet 33 to battery B. After the last impulse is delivered, the relay 67 opens the circuit of the private magnet 33, which, upon deenergizing, permits the side switch to advance from first to second position. The movement of the side switch wiper 29 from first to second position transfers the battery connection from the vertical magnet 27 to the rotary magnet 28. The calling subscriber now operates his calling device for the last digit 0, in response to which the connector line relay operates to transmit ten impulses through the rotary magnet 28 in series with the relay 67, whereby the shaft wipers are rotated onto the contacts of the desired line. This circuit extends from ground G^a through the springs 52 and 51, springs 64 and 65, relay 67, springs 70 and 71, rotary magnet 28 and the side switch wiper 29 (in second position) to battery B. The relay 67 operates in response to the impulses for this digit in the same manner as for the previous digit to cause the private magnet 33 to advance the side switch one more position, i. e., from second to third position.

The called substation is equipped with an individual line switch (not shown) similar in all respects to the line switch C, so that when the wipers 24, 25 and 26 of the connector E are rotated onto the contacts of the desired line, they are rotated onto contacts similar to the contacts 63, 72 and 73 of the line switch C. By the engagement of the side switch wipers 31 and 32 with their third-position contact points, the line connection is completed with the called line.

Upon the engagement of the wiper 30 with its third-position contact point, a circuit is completed through the cut-off winding of the called line switch. The said circuit extends from ground G^a through the side switch wiper 30, private wiper 25, bank contact 63 of the called line switch, springs similar to the springs 61 and 74 and through the cut-off winding to battery B. The cut-off winding of the called line switch, upon energizing, operates to disconnect the line relay from the called substation. The connection of ground G^a with the connector private bank contact of the called line prevents the called line from being seized by some other connector switch. By the engagement of the side switch wiper 29 with its third-position contact point, the circuit of the ringer relay 37 is closed. This circuit extends from ground G^a through the interrupter 75, relay 37, springs 77 and 76 and the side switch wiper 29 to battery B. The ringing relay disconnects the calling line from the called line and bridges the ringing current generator R across the called line to signal the called subscriber. The ringing relay is energized only intermittently through the medium of the interrupter 75. Upon the response of the called subscriber his line is provided with talking current through the windings of the back-bridge relay 36, which relay, upon energizing, closes the circuit through the ringer cut-off relay 78. The said circuit extends from ground G^a through the side switch wiper 30 (in third position), springs 79 and 80 and the relay 78 to battery B. The relay 78, upon energizing, interrupts the circuit of the ringing relay 37 at the springs 77 and 76 and closes a locking circuit for itself through the springs 81 and 82 independent of the springs 79 and 80.

After the conversation is completed, the connection is released by the hanging up of the receiver at the calling substation in the following manner: When the receiver at the substation A is restored to the switch-hook, the separating of the hook-switch springs destroys the energizing circuit of the connector line relay 35. The relay 35 is thereupon deenergized and opens the circuit of the relay 50. The relay 50, upon deenergizing, completes a circuit extending from ground G^a through the springs 52 and 51, springs 64 and 66, off-normal springs 83 and 84 and the release magnet 34 to battery B. The magnet, upon energizing, restores the switch shaft and side switch wipers to normal position and its own circuit is broken at the off-normal springs 83 and 84 when the shaft reaches its lowest position. The relay 50, upon deenergizing, also opens the holding circuit for the winding 12 and the relay 14 of the line switch C at the springs 54 and 55. The line switch C, upon becoming de-

energized, allows the plunger arm 9 to return to normal position.

It will now be explained how, when an attempt is made to establish a connection with a busy line, the line switch and connector are released and how the release of the line switch connects the busy signaling machine Q with the calling line to thus give the calling subscriber the busy signal.

If the called subscriber is busy, there will be a guarding potential upon the connector private bank contact, just as explained in connection with the line switch C. The connector private wiper 25, upon engaging this guarding contact and before the side switch wipers have passed to third position, completes an energizing circuit through the relay 85. This circuit extends from ground at the private bank contact through the private wiper 25, side switch wiper 30 (in second position), relay 85, springs 86 and 69 and the private magnet 33 to the battery B. The relay 85, upon energizing, opens the holding circuit for the winding 12 and the relay 14 of the line switch C. The winding 12, upon deenergizing, allows the armature 15 to fall back and the springs 38 and 43 to make contact with the springs 39 and 42, respectively. The plunger arm 9 is withdrawn from the bank of contacts 16 to 23, inclusive, thus opening the circuit of the relay 35 of the connector E at the springs 16, 20 and 19, 23. The deenergization of the line relay 35 allows the connector to release in the manner before mentioned. The springs 38 and 43 making contact with the springs 39 and 42 closes a circuit through the line relay 13 of the line switch C. The relay 14 being slow acting, the relay 13 energizes before the relay 14 has had time to deenergize and thus completes a holding circuit for the relay 14. The said circuit extends from ground G² through the springs 44 and 45, springs 46 and 87 and the relay 14 to battery B. The relay 14 remains energized over the above-traced circuit and retains the circuit of the pull-in winding 11 open at the springs 46 and 47. The line switch C is thus prevented from tripping and the cut-off armature 15 is prevented from operating. The relay 13, upon energizing, closes the contacts 88 and 89 and thus connects the busy signaling machine Q with the calling line. A busy signal is thus transmitted to the calling subscriber over the following path: from the busy machine Q through the springs 88 and 89, springs 43 and 42, conductor 41, through the substation A, conductor 40, springs 39 and 38 to ground G' and from ground G' to the busy machine Q. The subscriber, upon receiving the busy signal, replaces his receiver upon the receiver-hook. The replacing of the receiver upon the receiver hook allows the switch-hook springs 90 and 91 to separate,

which action opens the circuit of the line relay 13 and permits the relays 13 and 14 of the line switch C to return to normal.

It will thus be seen that I have devised a very efficient system in which, when the connector attempts to make connection with a busy line, the switches employed in establishing this connection will immediately be released and are thus in condition for further use. In this manner I prevent the switches and trunks employed in establishing this connection from being unnecessarily retained in use during the time elapsing between the time when the connector strikes a busy line and the calling subscriber hangs up his receiver. In this way I am enabled to greatly reduce the number of switches and trunks required in a telephone exchange and thus greatly increase the efficiency of the system. It will furthermore be seen that I have devised a very efficient means for transmitting a busy signal to the calling subscriber by having this signal associated with the individual line switch.

While I have illustrated my invention in connection with one particular type of automatic system, it will, of course, be understood that it is capable of use with many other forms of systems, and is equally as well adapted for use in connection with semi-automatic systems—that is, systems in which a manual link circuit is employed in combination with automatic means for establishing a connection between two subscribers' lines.

What I claim as my invention is:—

1. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, said switch provided with operating magnets for moving the switch first to elect a group of lines and for thereafter moving the switch to pick out a line in the elected group, said switch controlled over two sides of a calling line in series, means for extending a connection from a calling line to said connector switch, and means for automatically releasing said last connection upon said connector attempting to establish connection with a called line which is busy.

2. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, said switch provided with operating magnets for moving the switch first to elect a group of lines and for thereafter moving the switch to pick out a line in the elected group, means for extending a connection from a calling line to said connector switch, said connector switch controlled over two sides of the calling line in series, means for automatically releasing said last connection upon said connector attempting to establish connection with a called line which is busy, and means controlled by the release

of said last connection for releasing said connector.

3. In a telephone system, a subscriber's line, a line switch individual thereto, means for operating said switch to extend a connection from said line, a busy signaling machine associated with said switch, and means controlled by the release of said switch for connecting said busy signaling machine with the calling line.

4. In a telephone system, a subscriber's line, a line switch individual thereto, a busy signaling machine associated with said switch, means for operating said switch, means for releasing said switch when an attempt is made to establish connection with a busy line, and means controlled by the release of said switch for connecting said busy signaling machine with the calling line.

5. In a telephone system, a subscriber's line, a line switch individual thereto, a busy signaling machine associated with said switch, means for operating said switch, means for releasing said switch when an attempt is made to establish connection with a busy line, means controlled by the release of said switch for connecting said busy signaling machine with the calling line, and means controlled by the replacing of the receiver on the hook at the calling substation for disconnecting said busy signaling machine from the calling line.

6. In a telephone system, a calling subscriber's line, a called subscriber's line, a line switch individual to said calling line, an automatic connector switch adapted to establish connection with the called line, means for establishing connection from the line switch to said automatic switch, means for releasing said line switch when said connector attempts to make connection with a busy line, a busy signaling machine associated with said line switch, and means controlled by the release of said line switch for connecting said busy signaling machine with the calling line.

7. In a telephone system, a calling subscriber's line, a called subscriber's line, a line switch individual to said calling line, an automatic connector switch adapted to establish connection with the called line, means for establishing connection from the line switch to said automatic switch, means for releasing said line switch when said connector attempts to make connection with a busy line, a busy signaling machine associated with said line switch, means controlled by the release of said line switch for connecting said busy signaling machine with the calling line, and means controlled by the replacing of the receiver on the hook at the calling substation for disconnecting said busy signaling machine from the calling line.

8. In a telephone system, a calling line,

a line switch therefor for extending a connection from said line, a line relay for said switch bridged across said line and adapted to be energized when the subscriber removes his receiver from the hook, an operating magnet for said switch adapted to be energized by the operation of said line relay, and means for preventing the operation of said line relay from closing the circuit of said operating magnet when said switch is released while the calling subscriber has his receiver off the hook.

9. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, means including an automatic switch for extending connection from a calling line to said connector switch, a holding circuit for said last-mentioned switch, and means for opening said holding circuit when said connector attempts to establish connection with a busy line.

10. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, means including an automatic switch for extending connection from a calling line to said connector switch, a holding circuit for said last-mentioned switch, a relay in said connector, means for energizing said relay when said connector attempts to establish connection with a busy line, and means controlled by the energization of said relay for opening said holding circuit.

11. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, means including a line switch individual to the calling line for establishing connection with said connector, means for operating said line switch when the calling subscriber removes his receiver from the hook, a holding circuit for said line switch, and means for breaking said holding circuit when said connector attempts to establish connection with a busy line to thereby release said line switch.

12. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, means including a line switch individual to the calling line for establishing connection with said connector, means for operating said line switch when the calling subscriber removes his receiver from the hook, a holding circuit for said line switch, means for breaking said holding circuit when said connector attempts to establish connection with a busy line to thereby release said line switch, and means for preventing said line switch from again operating if the calling subscriber still has his receiver off the hook.

13. In a telephone system, a plurality of subscribers' lines, an automatic connector

- switch for establishing connection with a called line, means including a line switch individual, to the calling line for establishing connection with said connector, means for operating said line switch when the calling subscriber removes his receiver from the hook, a holding circuit for said line switch, means for breaking said holding circuit when said connector attempts to establish connection with a busy line to thereby release said line switch, and means controlled by the release of said line switch for transmitting a busy signal to the calling subscriber.
14. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, means including a line switch individual to the calling line for establishing connection with said connector, means for operating said line switch when the calling subscriber removes his receiver from the hook, a holding circuit for said line switch, means for breaking said holding circuit when said connector attempts to establish connection with a busy line to thereby release said line switch, means for preventing said line switch from again operating if the calling subscriber still has his receiver off the hook, and means controlled by the release of said line switch for transmitting a busy signal to the calling subscriber.
15. In a telephone system, a plurality of subscribers' lines, means including a plurality of automatic switches controllable over two sides of a line circuit in series for extending a connection from a calling line to a called line, and means for automatically releasing all of the switches in said connection when one of said switches attempts to make connection with a called line which is busy.
16. In a telephone system, a plurality of subscribers' lines, an automatic connector switch controllable over two sides of a line circuit in series for establishing connection with a called line, means for extending a connection from a calling line to said connector switch, and means for automatically releasing said last connection upon said connector attempting to establish connection with a called line which is busy.
17. In a telephone system, a plurality of subscribers' lines, an automatic connector switch controllable over two sides of a line circuit in series for establishing connection with a called line, means for extending a connection from a calling line to said connector switch, means for automatically releasing said last connection upon said connector attempting to establish connection with a called line which is busy, and means controlled by the release of said last connection for releasing said connector.
18. In a telephone system, a subscriber's line, a line switch individual thereto, means controllable over two sides of the line circuit in series for operating said switch to extend a connection from said line, a busy signaling machine associated with said switch, and means controlled by the release of said switch for connecting said busy signaling machine with the calling line.
19. In a telephone system, a subscriber's line, a line switch individual thereto, a busy signaling machine associated with said switch, means controllable over two sides of the line circuit in series for operating said switch, means for releasing said switch when an attempt is made to establish connection with a busy line, and means controlled by the release of said switch for connecting said busy signaling machine with the calling line.
20. In a telephone system, a subscriber's line, a line switch individual thereto, a busy signaling machine associated with said switch, means controllable over two sides of the line circuit in series for operating said switch, means for releasing said switch when an attempt is made to establish connection with a busy line, means controlled by the release of said switch for connecting said busy signaling machine with the calling line, and means controlled by the replacing of the receiver on the hook at the calling substation for disconnecting said busy signaling machine from the calling line.
21. In a telephone system, a calling subscriber's line, a called subscriber's line, a line switch individual to said calling line, an automatic connector switch controllable over two sides of a line circuit in series adapted to establish connection with the called line, means for establishing connection from the line switch to said automatic switch, means for releasing said line switch when said connector attempts to make connection with a busy line, a busy signaling machine associated with said line switch, and means controlled by the release of said line switch for connecting said busy signaling machine with the calling line.
22. In a telephone system, a calling subscriber's line, a called subscriber's line, a line switch individual to said calling line, an automatic connector switch controllable over two sides of a line circuit in series adapted to establish connection with the called line, means for establishing connection from the line switch to said automatic switch, means for releasing said line switch when said connector attempts to make connection with a busy line, a busy signaling machine associated with said line switch, means controlled by the release of said line switch for connecting said busy signaling machine with the calling line, and means controlled by the replacing of the receiver

on the hook at the calling substation for disconnecting said busy signaling machine from the calling line.

23. In a telephone system, a plurality of subscribers' lines, an automatic connector switch controllable over two sides of a line circuit in series for establishing connection with a called line, means including an automatic switch for extending connection from a calling line to said connector switch, a holding circuit for said last-mentioned switch, and means for opening said holding circuit when said connector attempts to establish connection with a busy line.

24. In a telephone system, a plurality of subscribers' lines, an automatic connector switch controllable over two sides of a line circuit in series for establishing connection with a called line, means including an automatic switch for extending connection from a calling line to said connector switch, a holding circuit for said last-mentioned switch, a relay in said connector, means for energizing said relay when said connector attempts to establish connection with a busy line, and means controlled by the energization of said relay for opening said holding circuit.

25. In a telephone system, a plurality of subscribers' lines, an automatic connector switch controllable over two sides of a line circuit in series for establishing connection with a called line, means including a line switch individual to the calling line for establishing connection with said connector, means for operating said line switch when the calling subscriber removes his receiver from the hook, a holding circuit for said line switch, and means for breaking said holding circuit when said connector attempts to establish connection with a busy line to thereby release said line switch.

26. In a telephone system, a plurality of subscribers' lines, an automatic connector switch controllable over two sides of a line circuit in series for establishing connection with a called line, means including a line switch individual to the calling line for establishing connection with said connector, means for operating said line switch when the calling subscriber removes his receiver from the hook, a holding circuit for said line switch, means for breaking said holding circuit when said connector attempts to establish connection with a busy line to thereby release said line switch, and means for preventing said line switch from again operating if the calling subscriber still has his receiver off the hook.

27. In a telephone system, a plurality of subscribers' lines, an automatic connector switch controllable over two sides of a line circuit in series for establishing connection with a called line, means including a line switch individual to the calling line for es-

ablishing connection with said connector, means for operating said line switch when the calling subscriber removes his receiver from the hook, a holding circuit for said line switch, means for breaking said holding circuit when said connector attempts to establish connection with a busy line to thereby release said line switch, and means controlled by the release of said line switch for transmitting a busy signal to the calling subscriber.

28. In a telephone system, a plurality of subscribers' lines, an automatic connector switch controllable over two sides of a line circuit in series for establishing connection with a called line, means including a line switch individual to the calling line for establishing connection with said connector, means for operating said line switch when the calling subscriber removes his receiver from the hook, a holding circuit for said line switch, means for breaking said holding circuit when said connector attempts to establish connection with a busy line to thereby release said line switch, means for preventing said line switch from again operating if the calling subscriber still has his receiver off the hook, and means controlled by the release of said line switch for transmitting a busy signal to the calling subscriber.

29. In a telephone system, a connector, a front bridge in said connector for controlling the operation thereof, means for opening said bridge when said connector lands on a busy line, and means controlled by the opening of said bridge for releasing said connector.

30. In a telephone system, a connector, talking conductors extending through said connector, said conductors divided into two inductively connected sections, one on the calling subscriber's side and one on the called subscriber's side, a relay bridged across the conductors of the calling side for controlling the operation of said connector and means for automatically operating said relay when the connector lands on a busy line.

31. In a telephone system, a calling line, a called line, a pair of progressively movable trunking switches for connecting the two over a talking circuit, means for operating said switches, a release equipment for releasing said switches, a holding circuit separate from the talking conductors for preventing the release of said switches during talking, and means for rendering said holding circuit inoperative when the called line is busy for releasing said switches.

32. In a telephone system, a calling line, a called line, a pair of progressively movable trunking switches for connecting the two over a talking circuit, means for operating the said switches over two sides of

the calling line in series, a release equipment for releasing said switches, a holding circuit separate from the talking conductors for preventing the release of said switches during talking, and means for rendering said holding circuit inoperative when the called line is busy for releasing said switches.

33. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, said switch provided with operating magnets for moving the switch first to elect a group of lines and for thereafter moving the switch to pick out a line in the elected group, said switch controlled over two sides of a calling line in series, means for extending a connection from a calling line to said connector switch, and a relay for automatically releasing said last connection upon said connector attempting to establish connection with a called line which is busy.

34. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, said switch provided with operating magnets for moving the switch first to elect a group of lines and for thereafter moving the switch to pick out a line in the elected group, means for extending a connection from a calling line to said connector switch, said connector switch controlled over two sides of the calling line in series, means for automatically releasing said last connection upon said connector attempting to establish connection with a called line which is busy, and a relay controlled by the release of said last connection for releasing said connector.

35. In a telephone system, a subscriber's line, a line switch individual thereto, means for operating said switch to extend a connection from said line, a busy signaling machine associated with said switch, and a line relay controlled by the release of said switch for connecting said busy signaling machine with the calling line.

36. In a telephone system, a subscriber's line, a line switch individual thereto, a busy signaling machine associated with said switch, means for operating said switch, a circuit for releasing said switch when an attempt is made to establish connection with a busy line, and electromagnetic means controlled jointly over said circuit and the said subscriber's line for connecting said busy signaling machine with the calling line.

37. In a telephone system, a calling line, a line switch therefor for extending a connection from said line, a line relay for said switch bridged across said line and adapted to be energized when the subscriber removes his receiver from the hook, an operating magnet for said switch adapted to be ener-

gized by the operation of said line relay, a second relay for preventing the operation of said line relay from closing the circuit of said operating magnet when said switch is released while the calling subscriber has his receiver off the hook, and a busy signaling circuit closed by the energization of said line relay while the said operating magnet remains inoperative.

38. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, means including a line switch individual to the calling line for establishing connection with said connector, means for operating said line switch when the calling subscriber removes his receiver from the hook, a holding circuit for said line switch, means for breaking said holding circuit when said connector attempts to establish connection with a busy line to thereby release said line switch, and a circuit controlled by the release of said line switch for transmitting a busy signal to the calling subscriber.

39. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with a called line, means including a line switch individual to the calling line for establishing connection with said connector, means for operating said line switch when the calling subscriber removes his receiver from the hook, a holding circuit for said line switch, means for breaking said holding circuit when said connector attempts to establish connection with a busy line to thereby release said line switch, a relay for preventing said line switch from again operating if the calling subscriber still has his receiver off the hook, and a circuit controlled by the release of said line switch for transmitting a busy signal to the calling subscriber.

40. In a telephone system, a plurality of subscribers' lines, means including a plurality of automatic switches controllable over two sides of a line circuit in series for extending a connection from a calling line to a called line, and a relay for automatically releasing all of the switches in said connection when one of said switches attempts to make connection with a called line which is busy.

41. In a telephone system, a plurality of subscribers' lines, an automatic connector switch controllable over two sides of a line circuit in series for establishing connection with a called line, means for extending a connection from a calling line to said connector switch, and a busy test relay for automatically releasing said last connection upon said connector attempting to establish connection with a called line which is busy.

42. In a telephone system, a subscriber's line, a line switch individual thereto, a busy signaling machine associated with said

switch, means controllable over two sides of a line circuit in series for operating said switch, means for releasing said switch when an attempt is made to establish connection
5 with a busy line, and a relay controlled thereafter over the said subscriber's line for connecting said busy signaling machine thereto.

10 43. In a telephone system, a connector, a front bridge in said connector for controlling the operation thereof, a test relay for

opening said bridge when said connector lands on a busy line, and a circuit controlled by the opening of said bridge for releasing said connector.

Signed by me at Chicago, Cook county,
Illinois, this 16th day of January, 1914.

JEROME E. COOLEY.

Witnesses:

HARRY E. HERSHEY,

GEO. A. YANOWSKI.